4.9 GEOLOGY, SOILS, AND SEISMICITY

4.9.1 Impact Methodology

Geologic impacts include all of the effects that result from the interaction between the project and the geologic environment. For example, project impacts could include changes in erosion rates or changes in the level of exposure of people and structures to earthquakes or unstable slopes.

Identifying project impacts relied heavily on the use of available geologic studies, reports, observations, and engineering judgment to make reasonable inferences about the potential effects of the project, given the interpretation of the geologic setting described in the affected environment sections. In addition, some geologic impacts were evaluated in the context relative to regulatory requirements or guidelines. Regulatory requirements include state and local building codes, grading ordinances, and restrictions on development in protected areas or in areas subject to specific geologic hazards.

In order to provide additional information about existing concentrations of chemical constituents in soils, the Army performed a soil investigation of training ranges at SBMR and PTA. The results of this investigation were evaluated and compared to USEPA Region IX industrial soil PRGs to identify potential chemicals of concern and to determine if exposure to these chemicals in soils might impact human health.

Also, results from ATTACC modeling conducted by the Army were considered in evaluating the impacts of training on land condition, including effects such as soil erosion and compaction and damage to vegetation.

4.9.2 Factors Considered for Impact Analysis

The significance of the project impacts is defined in both relativistic and absolute terms. Relativistic criteria base significance on context and tend to be subjective, while absolute criteria are defined in terms of objective standards.

Factors considered in determining whether an alternative would have a significant impact on geology include the extent or degree to which its implementation would:

- Increase the exposure of people or structures to geologic hazards (for example, ground shaking, liquefaction, volcanism, slope failure, expansive soils, hazardous constituents of soils) that could result in injury, acute or chronic health problems, loss of life, or major economic loss;
- Result in a substantial loss of soil (such as through increased erosion), or loss of access to economically significant mineral deposits;
- Adversely affect human health or environmental receptors, such as through exposure to toxic chemicals or irritants present in geologic materials;
- Adversely alter existing geologic conditions or processes such that the existing or potential benefits of the geologic resource are reduced (for example, construction of

a jetty that would interfere with sand transport processes and beach formation or would increase shore erosion);

- Conflict with existing federal, state, or local statutes or regulations;
- Permanently damage or alter a unique or recognized geologic feature or landmark;
- Substantially alter the existing function of the landscape (for example, altering drainage patterns through large-scale excavation, filling, or leveling); or
- Disturb or alter unique, rare, or otherwise important paleontological resources such that the potential to derive benefits from those resources is reduced. (Note that paleontological resources may also be addressed with archaeological resources under the general heading of cultural resources.)

In addition to these factors, public concerns expressed during the scoping process were also considered in the impact analysis. These concerns included the cumulative effects of residual contaminants, such as lead and explosives compounds, from past waste disposal and munitions use, and several comments expressed a concern that existing contamination be remediated prior to undertaking new actions. Some of the public comments related to soils that are susceptible to erosion, especially in the WPAA, where wind erosion and windblown dust were identified as a major concern in several comments.

4.9.3 Summary of Impacts

Table 4-9 lists the types of geological impacts associated with the Proposed Action and No Action at the relevant installations.

Proposed Action (Preferred Alternative)

Significant Impacts

Impact 1: Soil loss from training activities. ATTACC modeling results suggest that soil erosion may be significantly increased by training activities under the Proposed Action at SBMR, DMR, KTA, and PTA, due to increased intensity of use within limited maneuver areas. Also, the amount of land subject to increased soil erosion would increase at SBMR and PTA, relative to the No Action Alternative. The ATTACC modeling results indicate that increased training intensity would severely degrade the condition of the land. This qualitative conclusion is based on evaluating a variety of factors, including soil erodibility, which is weighted relatively heavily. The following mitigation measures will substantially reduce the impacts but not to less than significant levels.

Regulatory and Administrative Mitigation 1. The Army will develop and implement a DuSMMoP for the training area. The plan will address measures such as, but not limited to, restrictions on the timing or type of training during high risk conditions, vegetation monitoring, soil monitoring, and buffer zones to minimize dust emissions in populated areas. The plan will determine how training will occur in order to keep fugitive dust emissions below CAA standards for PM_{10} and soil erosion and compaction to a minimum. The Army will monitor the impacts of training activities to ensure that emissions stay within the acceptable ranges, as predicted, and that environmental problems do not result from excessive soil erosion or

compaction. The plan will also define contingency measures to mitigate the impacts of training activities that exceed the acceptable ranges for dust emissions or soil compaction.

Table 4-9
Summary of Potential Geologic and Soil Impacts

	SBMR			DMR			KTA/KLOA			PTA			Project-wide Impacts		
Impact Issues	**PA**	**RLA**	**NA**	**PA**	**RLA**	**NA**	**PA**	**RLA**	**NA**	**PA**	**RLA**	**NA**	**PA**	**RLA**	**NA**
Soil loss from training activities	⊗	⊘	⊘	⊗	⊗	○	⊗/○	⊗/○	⊘/○	⊗	⊗	⊙	⊗	⊗	⊘
Soil erosion and loss from wildland fires	⊘	⊘	⊘	⊘	⊘	⊙	⊘/⊘	⊘/⊘	⊘/⊘	⊘	⊘	⊘	⊘	⊘	⊘
Soil compaction	⊘	⊙	⊙	○	○	○	⊙/○	⊙/○	○/○	⊘	⊘	⊙	⊘	⊘	⊙
Exposure to soil contaminants	⊙	⊙	⊙	○	○	○	⊙/○	⊙/○	○/○	⊙	⊙	⊙	⊙	⊙	⊙
Slope failure	⊘	⊘	○	⊘	⊘	○	⊙/⊙	⊙/⊙	⊙/⊙	⊙	⊙	⊙	⊘	⊘	⊙
Volcanic and seismic hazards	○	○	○	⊙	⊙	⊙	⊙/○	⊙/○	⊙/○	⊙	⊙	⊙	⊙	⊙	⊙

This table summarizes project-wide impacts. For installation-specific impacts see Chapters 5 – 8.
In cases when there would be both beneficial and adverse impacts, both are shown on this table. Mitigation measures would only apply to adverse impacts.

LEGEND:

⊗ = Significant
⊘ = Significant but mitigable to less than significant
⊙ = Less than significant
○ = No impact
\+ = Beneficial impact
N/A = Not applicable
PA = Proposed Action
RLA = Reduced Land Acquisition
NA = No Action

The Army will implement land management practices and procedures described in the ITAM annual work plan to reduce erosion impacts (USARHAW 2001a). Currently these measures include implementation of a training requirement integration (TRI) program; implementation of an Integrated Training Area Management (ITAM) program; Sustainable Range Awareness (SRA) program; development and enforcement of range regulations; implementation of an Erosion and Sediment Control Management Plan; coordinating with other participants in the Koolau Mountains Watershed Partnership (KMWP); and continued implementation of land rehabilitation projects, as needed, within the Land Rehabilitation and Maintenance (LRAM) program. Examples of current LRAM activities at KTA include revegetation projects involving site preparation, liming, fertilization, seeding or hydroseeding, planting trees, irrigation, and mulching; a combat trail maintenance program (CTP); coordination through the Troop Construction Coordination Committee (TCCC) on road maintenance projects; and development of mapping and GIS tools for identifying and tracking progress of mitigation measures.

Significant Impacts Mitigable to Less than Significant

Impact 2: Soil erosion and loss from wildland fires. As described in the water resources section, fire could cause an increase in soil erosion by removing vegetation that normally slows runoff, intercepts raindrops before they reach the soil surface, and anchors the soil. In areas with

steep slopes and rapid runoff, erosion can cause rapid removal and redeposition of soils, gullying, or unstable slopes. This is considered a potentially significant but mitigable impact at all installations, and along the tank trails between installations. The effects would be least at DMR, because there is less vegetation and slopes are generally flatter, and at KTA, because of the wetter climate there. The following mitigation will reduce the impacts to less than significant levels.

Regulatory and Administrative Mitigation 2. The IWFMP for Pōhakoloa and O'ahu Training Areas was updated in October 2003. The Army will fully implement this plan for all existing and new training areas to reduce the impacts associated with wildland fires. The plan is available upon request.

Additional Mitigation. None identified.

Impact 3: Soil Compaction. Soils in training areas, and especially in areas that have not previously been used for maneuver training, such as the SRAA at SBMR, or portions of the WPAA, are likely to become compacted by use of tracked or wheeled vehicles, potentially affecting their ability to support vegetation and altering their permeability and moisture retention capacity. Widespread compaction could generally reduce recovery of vegetation cover. Preferred drainage pathways could develop along the compacted linear track left by off-road vehicles, creating increased erosion along the tracks. The impacts of these changes are considered to be significant depending on the amount of land area affected. ATTACC modeling results suggest that a large proportion of the land area in the maneuver areas could be affected. The following mitigation will reduce the impacts to less than significant levels.

Regulatory and Administrative Mitigation 3. Some areas may be more vulnerable to these impacts than others, because of soil characteristics, depth, existing conditions, soil moisture, or other conditions. Expansion of the ITAM Program, as discussed in Regulatory and Administrative Mitigation 1, will mitigate this impact.

Impact 4: Slope Failure. Construction and use of Helemanō Trail and Dillingham Trail may increase the potential for slope failure adjacent to the roads. Each road includes segments that would traverse soils with high erosion hazards, on or adjacent to steep slopes. Construction of the roads may require widening existing roads and cutting or filling slopes, leading to potential slope failure. Intense use of the roads by heavy vehicles could result in loading of weakly supported slopes that could also contribute to slope failure. Roads can alter drainage patterns, leading to poor drainage or flooding, increasing runoff rates and volumes, or focusing runoff at points of discharge that may become sites of rapid erosion. Each of these conditions could contribute to hazards of slope failure in susceptible areas. This is considered a potentially significant impact because slope failure could result in disfigurement of the landscape, obstruction of stream channels, safety problems, and interruption of the use of the road. The following mitigation will reduce the impacts to less than significant levels.

Regulatory and Administrative Mitigation 4. None proposed.

Additional Mitigation 4. The Army proposes to minimize or avoid cut, where practicable. Cut slopes would be blended into the landscape by rounding the edges of the slope, differential orientation of the slope and the roadbed alignments where practicable. Use of these techniques would be varied based on the specific conditions, including depth of the cut, orientation of the slope, and type of material (e.g., dirt slope and rock slope). In accordance with Army design standards, potential mitigation measures for this impact also include, where practicable, selecting the least failure-prone route, geotechnical testing soils where necessary along the route to identify problems, designing the roadbed, slope and surface to avoid slope failure, properly sizing drainage systems, designing storm drainage outfalls for efficient performance, and properly monitoring and maintaining the road.

Less than Significant Impacts

Exposure to Soil Contaminants. An important factor in evaluating risk due to exposure to contaminated soils is the fact that munitions are fired from firing points down range and into the range impact areas. These areas are not accessible to or entered by soldiers or members of the public because of the safety explosive risk they represent. Therefore, it is unlikely that human beings, either military personnel or off-post residents, would come into contact with the constituents of these munitions in the downrange or impact area soils. Taken together, the chemical concentrations on the training ranges represent a low risk to personnel who use the ranges. There would be no threat to the general public from munitions constituents related to range use because there would be no public access to these areas.

Based on the analysis described above, this represents a less than significant impact at SBMR.

With regard to the presence of pesticides in land within the SRAA, the USEPA has investigated pesticide use in the Del Monte plantation lands surrounding Kunia, and did not find unusual concentrations of farm chemicals in the SRAA (the Kunia Plantation Superfund Site investigations are discussed further in Section 5.11).

The only area that presents a potential opportunity for contact with contaminated soils is in the area of the proposed BAX at PTA. The construction of the BAX will require the conversion of a portion of Training Area 12 to a training area where soldiers could be exposed to the soils. However their exposure would be limited to training for a period of days or weeks. The level of chemical compounds present at Range 12 are all below their respective PRGs. Considered together, the potential duration of exposure to the chemical concentrations on the training ranges at PTA, including Range 12, represent a low risk to personnel who use them.

As discussed in the Affected Environment section, composite soil sampling at selected ranges within PTA revealed the presence of metals, explosives, and semi-volatile organic compounds. The observed concentrations were generally less than industrial PRGs. One explosive compound, RDX, was detected in samples from Ranges 5 and 9 at concentrations above the industrial PRG while Training Area 12 was below. The risks from multiple chemical exposures are additive, and similar calculations can be done for each of the contaminants to which people may be exposed at PTA. The risks from HMX, nitroglycerin, and TNT are very small compared to the risk from RDX, and the sum of their risks is less

than 0.74 x 10^{-6}. The risks associated with each of the metals can be calculated similarly, and the results would be similar. The highest risks are associated with the iron and aluminum in the soil, both of which occur naturally at high concentrations.

Maneuver training conducted in the WPAA would not result in significant exposures to high explosives residues in soils, either from past or proposed activities, because the training there under the Proposed Action would involve simulated rather than live artillery fire.

Overall, the sum of the carcinogenic and non-carcinogenic risks, based on the available soil sampling data and using the PRGs to estimate risk, is less than the EPA threshold for worker exposure. It is unlikely that troop exposures to RDX or other chemicals on the ranges would be similar to worker exposures in an industrial setting. For example, workers are assumed to ingest 100 mg of soil per day, 250 days per year for 25 years. This assumption over-estimates troop exposures, because troops are likely to be exposed only temporarily, and only for short durations. Based on the conservative analysis described above, this represents a less than significant impact.

Volcanic and seismic hazards. PTA is subject to volcanic eruptions, lava flows, occasional explosive eruptions, and volcanic gas venting, and earthquakes. The Proposed Action would increase the hazard associated with these conditions relative to No Action because it would involve constructing additional structures and increasing personnel. While the hazard associated with an eruption of lava or volcanic gases is high if directed toward an area occupied by people or structures, the probability of a lava flow occurring within the PTA during the next 50 to 100 years is low, based on the frequency with which this has occurred in the past. (There are no historical lava flows within PTA.) Also, existing warning systems are expected to generally provide sufficient warning of an eruption that personnel and equipment would probably have time to evacuate from the path of a lava flow. The hazards associated with future earthquakes at PTA are considered less than significant because new structures would be designed to withstand the expected range of seismic shaking and because the area is underlain by thin soils and hard rock, which, unlike thick alluvial deposits, transmits rather than amplifies seismic wave energy. Most earthquakes in the Hawaiian Islands are centered on the south side of the island of Hawai'i or beneath one of the active volcanoes (Kīlauea and Mauna Loa). On O'ahu, the expected intensity of ground shaking in a reasonably probable earthquake would be moderate to low because of its distance from the source of the earthquakes. There is very little risk of renewed volcanic activity on O'ahu, so the impacts there are considered less than significant.

Reduced Land Acquisition Alternative

The geologic impacts under Reduced Land Acquisition would be nearly the same as those described for the Proposed Action, except that impacts would be substantially reduced in the SRAA. This would result in reduced impacts related to soil erosion and soil compaction in this area but would result in increased impacts in areas where training would be concentrated. There would be a less than significant impact on soil compaction at SBMR as a result of this change, because no maneuver training would take place at the SRAA, but all other impacts would remain the same. Mitigation would be the same as that under the Proposed Action, except that it is likely to be less successful because, with reduced land

available for training, the impacts of training would be concentrated on a smaller amount of land. One of the available mitigation measures is to take damaged land out of service until it recovers; but this measure would be less feasible if training were concentrated in a smaller land area. The impact from exposure to contaminated soils would be the same as for the Proposed Action, and would be less than significant for the same reasons described above.

No Action Alternative

Many of the impacts discussed under the Proposed Action would also occur under No Action but at a different magnitude or level of significance. Only the differences relative to the Proposed Action are discussed here.

Soil loss from training activities. ATTACC modeling indicates that current land condition is good, i.e. no impact, at DMR and PTA, and that damage that occurs under current training conditions at SBMR and KTA is significant but mitigable to less than significant with application of the ITAM Program. The INRMP for installations on O'ahu suggests that severe soil erosion has occurred in the past in certain ridge top areas at SBMR. Those areas are expected to be addressed through the ITAM process and will gradually recover under improved land management.

Soil erosion and loss from wildland fires. Under the No Action Alternative, the potential for wildland fires would be about the same as those under existing conditions. If wildland fires occur, they can cause a severe increased hazard of soil erosion because of the removal of vegetative cover resulting in a significant impact. Mitigation would be the same as that described for the Proposed Action and would reduce the impact to less than significant.

Soil Compaction. Soils in training areas would be subject to existing levels of compaction. Most of these effects have already occurred, although continued maneuver training would reduce the ability of soils to recover from these effects and impacts would be less than significant.

Exposure to soil contaminants. The impact from exposure to contaminated soils would be the same as for the Proposed Action, and would be less than significant for the same reasons described above.

Slope Failure. Slope failure is not considered a significant impact of No Action because it has not been identified as a significant problem under existing conditions, and No Action would not result in any substantial change in land use compared to existing conditions.

Volcanic and Seismic hazards. The potential for strong ground motion or volcanic eruptions that could present a hazard to people or property would be the same as that described for the Proposed Action. The impacts would be greatest at PTA, but they are not expected to be significant.